REMARKS

Claims 1, 3, 6-9, 12-23, 25-30, 34, 37-40, 42-49, 52, 54, 58-60, 63-71, and 73-77 have been amended for clarification purposes. Claims 1-23, 25-71, and 73-77 are currently pending in this application. Applicant reserves the right to pursue the original claims and other claims in this and other applications.

Claims 1, 8-11, 30-32, 39-41, 52, and 59-62 stand rejected under 35 U.S.C. § 102(e) as being unpatentable over U.S. Patent No. 6,768,149 ("Mann"). This rejection is respectfully traversed.

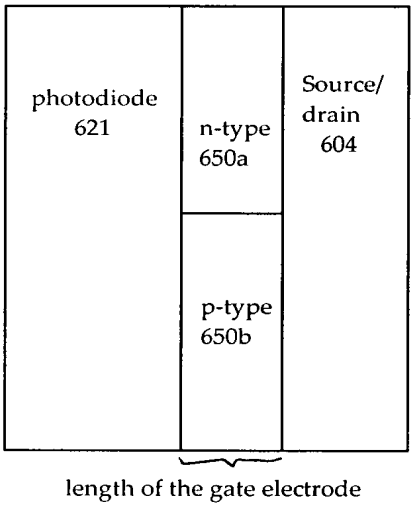
Applicant respectfully submits that Mann fails to disclose, teach or suggest "at least one gate electrode region extending the length of the gate electrode and having a substantially uniform dopant type and concentration and a work-function greater than a work-function of n+ Si," as recited in claims 1, 30, and 52. The length of the gate electrode is further claimed as "extending from a source/drain region to the photo-conversion device." As such, the transistor recited in claims 1, 30, and 52 has at least one gate electrode region with a work-function greater than that of n+ Si and extending from the source/drain region to the photo-conversion device. *See* specification at FIG. 6A.

In contrast, the two gate electrode regions 312, 314 (FIG. 3) in Mann each extends across only a portion of the length of the gate electrode from the source 306 to the photo-detector 310. That is, only one-type of gate electrode region 314 (e.g., p-type) is on the photo-detector 310 side while the other type of gate electrode region 312 (e.g., n-type) is on the source 306 side. Mann at FIG. 3. Mann discloses a transistor 302 having a gate 304, a source 306, and a drain 308. "The gate 304 has a n-type region 312, a p-type region 314, and a dielectric insulator 316." Mann at ¶ 0026. "The drain 308 of the transistor 302 is connected to the deep implant 316 of photo-detector 310 . . . and is

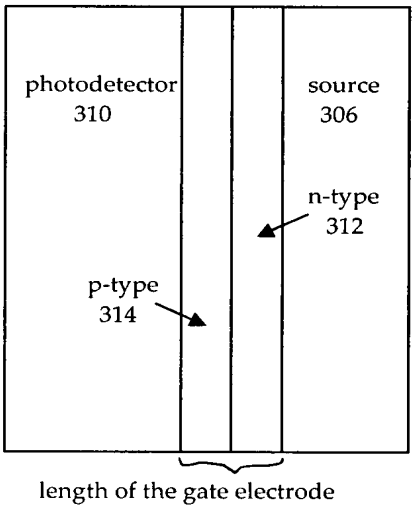
partially beneath the p-type region 314 of the gate 304." Mann at ¶¶ 0026 and 0029. "The source 306 is formed with a p-type well 318, and [is] partially beneath the n-type [region] 312 of gate 304." Mann at ¶ 0028. Therefore, each gate electrode region 312, 314 extends across only a portion of the length of the gate electrode wherein the gate electrode extends from the source 306 to the photo-detector 310.

This difference is easily seen in the top plan views of an embodiment of the present invention and Mann illustrated below. The top plan view of an embodiment of the present invention is a reproduction of a portion of FIG. 6A in the specification. The top plan view of the sensor disclosed in Mann is based on FIG. 3 of Mann.

Claimed Embodiment



Mann



Here, Applicant's gate electrode regions 650a, 650b (n-type and p-type) each extend the defined length of the gate electrode, with the n-type region 650b having a work function greater than n+ Si, as recited in claims 1, 30, and 52. *See also* specification

at ¶ 0068. Mann's gate electrode region 312 (n-type), however, does not extend across the defined length of the gate electrode.

There are important consequences due to this structural difference. Embodiments of the present invention enhance potential barriers and wells in a pixel cell having a photo-conversion device, such as a pinned photodiode, using the gate work function engineering. Mann, on the other hand, uses gate work function to increase the threshold voltage of the reset device without increasing the doping level.

Enhancing the potential barrier near the transfer gate region is difficult and complex. In an embodiment of the present invention, as shown for example in FIG. 6B, by having a channel portion "Db" with lower doping level, the potential barrier can be lowered selectively – compared to channel portion "Da." Specification at ¶ 0040. Moreover, even if a high potential barrier results near the critical "overlap" region (i.e., where the photo-conversion device and the transistor are in close proximity to one another), there can be one channel portion that has a low potential barrier for charges to leak into. This can significantly reduce image lag.

Neither the limitations of claims 1, 30, and 52 nor the above advantages are disclosed, taught or suggested in Mann. Accordingly, claim 1, 30, and 52 are patentable over Mann.

Claims 8-11 depend from claim 1 and are allowable along with claim 1. Claims 31, 32, 39-41 depend from claim 30 and are allowable along with claim 30. Claims 59-62 depend from claim 52 and are allowable along with claim 52. For at least the reasons stated above, Applicant respectfully requests the withdrawal of the rejection and allowance of the claims.

Claims 2, 7, 12-13, 33, 38, 53, and 58 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mann. This rejection is respectfully traversed.

As discussed above, Mann fails to disclose, teach or suggest all limitations of claims 1, 30, and 52. For the same reasons that Mann does not anticipate claims 1, 30, and 52, Mann does not render claims 1, 30, and 52 obvious.

Claims 2, 7, 12, and 13 depend from claim 1 and are allowable along with claim 1. Claims 33 and 38 depend from claim 30 and are allowable along with claim 30. Claims 53 and 58 depend from claim 52 and are allowable along with claim 52. Accordingly, Applicant respectfully requests the withdrawal of the rejection and allowance of the claims.

Claims 3-6, 34-37, and 54-57 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mann in view of Ponomarev (Gate-Work-Function Engineering Using Poly-(Si, Ge) for High-Performance 0.18 μm CMOS technology, IEDM 1997). This rejection is respectfully traversed.

As discussed above, Mann fails to disclose, teach or suggest all limitations of claims 1, 30 and 52. Ponomarev is cited for teaching a gate comprising a mid-gap material including SiGe. Ponomarev, however, fails to cure the deficiencies of Mann. Therefore, even when considered in combination, the cited references fail to teach or suggest all limitations of claims 1, 30 and 52.

Claims 3-6 depend from claim 1 and are allowable along with claim 1. Claims 34-37 depend from claim 30 and are allowable along with claim 30. Claims 54-57 depend from claim 52 and are allowable along with claim 52. Accordingly, Applicant respectfully requests the withdrawal of the rejection and allowance of the claims.

Claims 49-51 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mann in view of U.S. Patent No. 6,198,087 ("Boon"). This rejection is respectfully traversed.

Claim 49, although different in scope, recites similar limitations as claims 1, 30, and 52. Specifically, claim 49 recites a processor system comprising a pixel. The pixel of claim 49, in turn, comprises "at least one gate electrode region extending the length of the gate electrode and having a substantially uniform dopant type and concentration and a work-function greater than a work-function of n+ Si." The length of the gate electrode is further claimed as "extending from a source/drain region to the photo-conversion device." Mann fails to disclose, teach or suggest these limitations of claim 49. Boon, which has been cited for teaching a processor and an image sensor coupled to the processor, fails to cure the deficiencies of Mann. Therefore, even when considered in combination, the cited references fail to teach or suggest all limitations of claim 49.

Claims 50 and 51 depend from claim 49 and are allowable along with claim 49. Accordingly, Applicant respectfully requests the withdrawal of the rejection and allowance of the claims.

In view of the above, Applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

By_____

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